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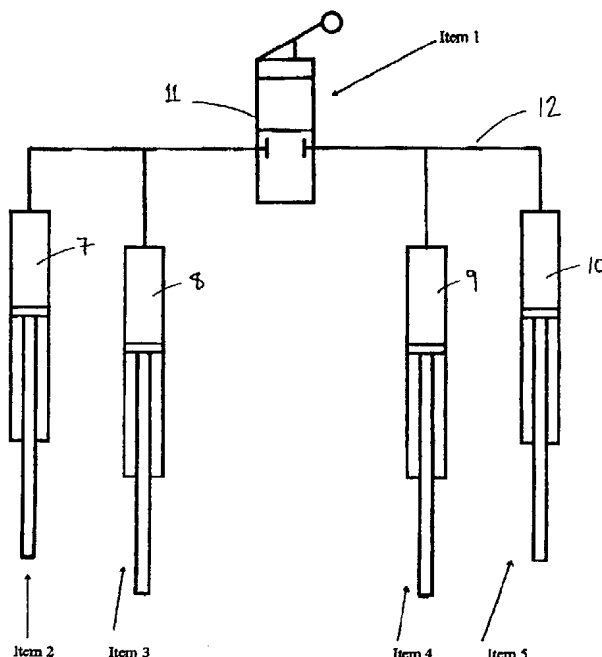
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(54) Abstract Title

**Hydraulic levelling systems**

(57) A hydraulic device for levelling a structure such as a ladder (Fig 2) comprises at least four pistons, four cylinders 7-10, a valve 11 and tubing 12. The tubing is between the valve and the cylinders and each piston fits inside a cylinder with a fluid seal. Each piston is in fluid communication with the valve and the position of the piston with respect to the cylinder is capable of being adjusted by adjusting the amount of hydraulic fluid in the tubing between the piston and the valve. The valve is positioned between groups of cylinders/pistons e.g. 7 and 8, 9 and 10 wherein each group is in fluid communication and linked by tubing with no valve. A further lifting piston and cylinder may be provided.

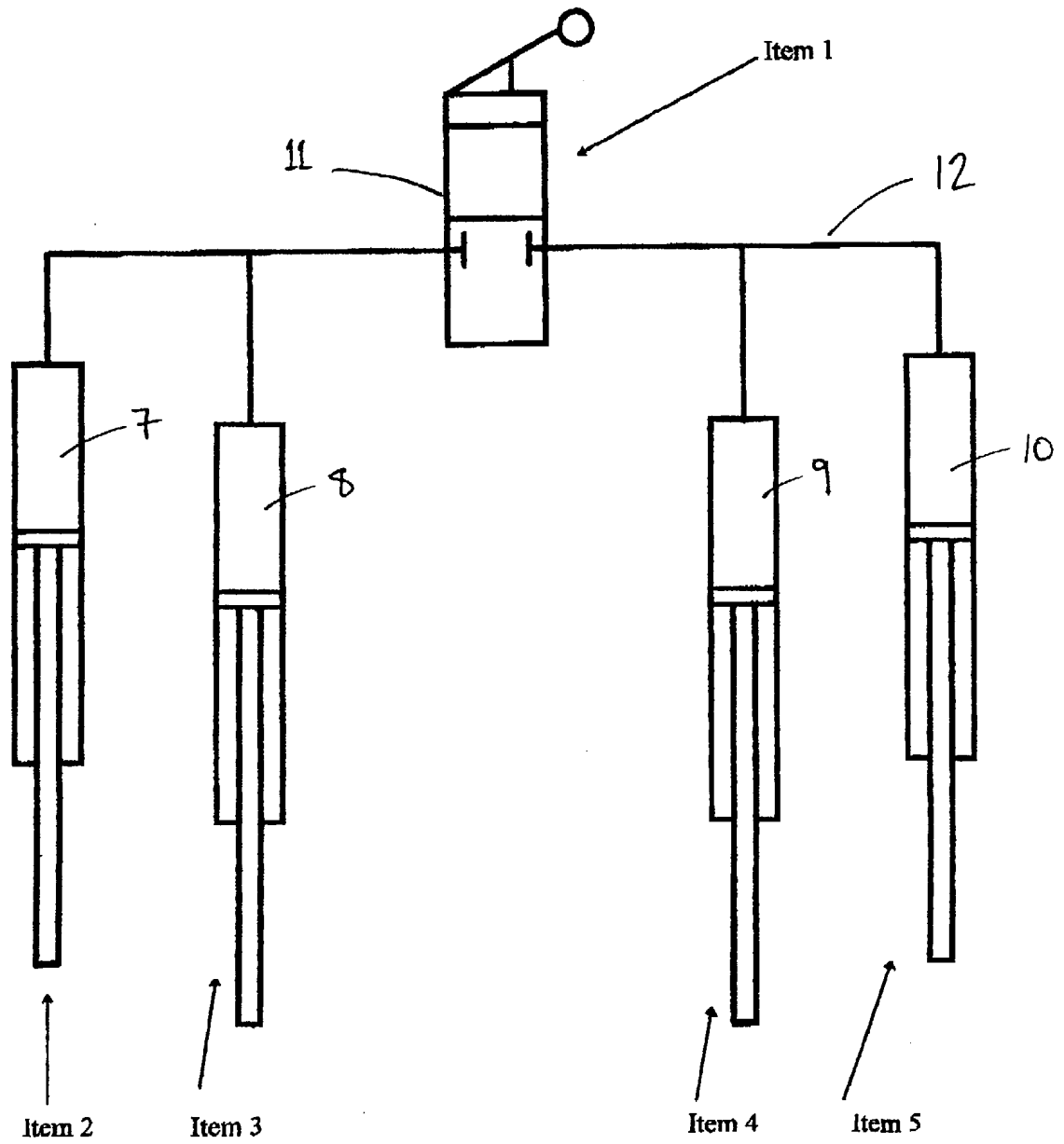


At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

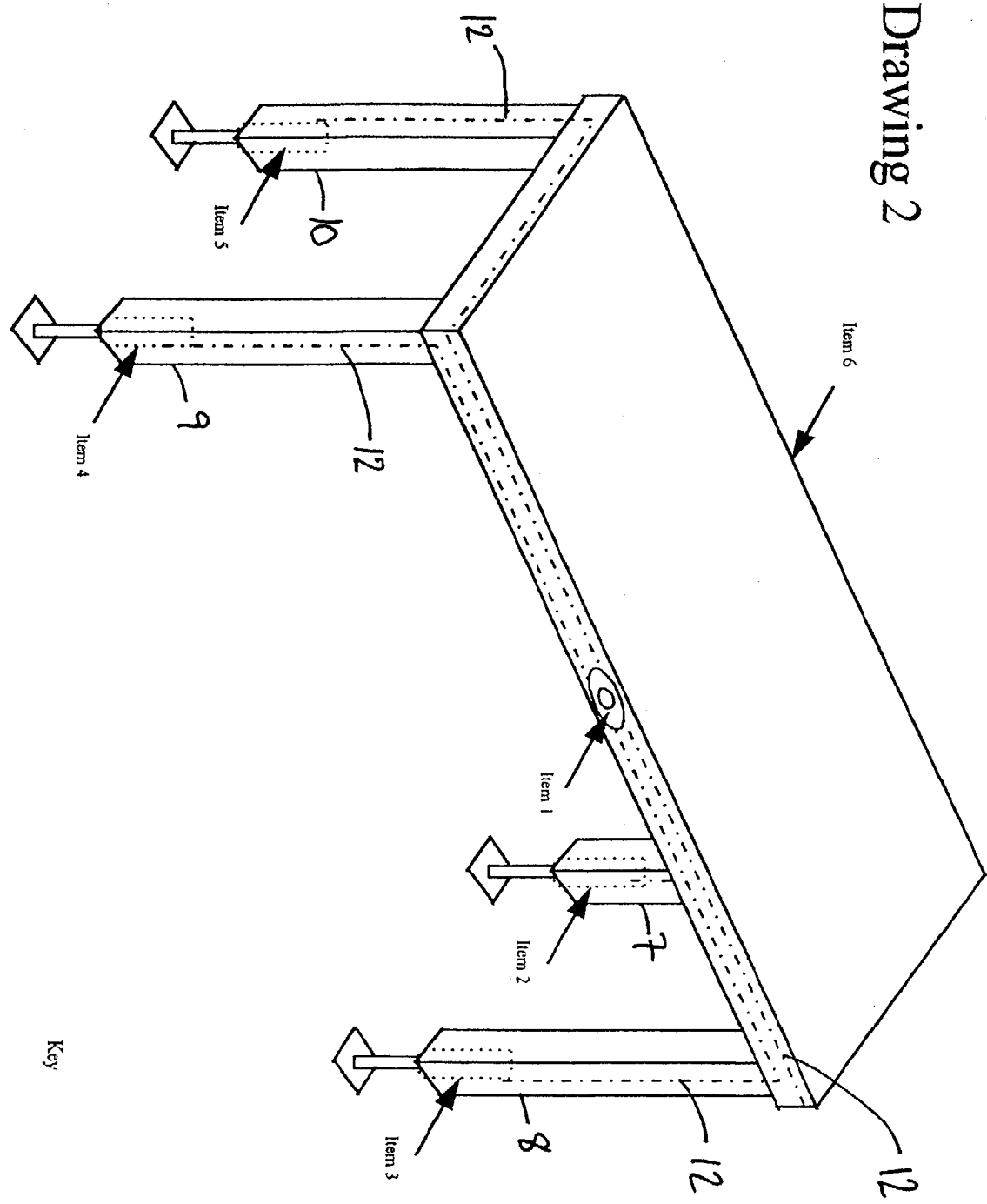
This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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Drawing 1



# Drawing 2



Key

----- Hydraulic Pipe

## Hydraulic Levelling System

This invention relates to a hydraulic device for levelling a structure such as a ladder, which comprises at least one piston and a valve. In addition, the invention relates to a  
5 method for levelling a structure such as a ladder which comprises the steps of adjusting the level of hydraulic fluid in at least one piston.

Within the context of this specification the word “comprises” is taken to mean “includes, among other things”. It is not intended to be construed as “consists of  
10 only”.

There are many items or structures having platforms that are required to be level, for operational and/or safety reasons. For example, it is desirable to arrange the platforms of scaffolding, ladders, tables or chairs so that they are not subject to wobbling even if  
15 they are placed on an uneven surface. In addition it is desirable that they are flat and secure even over an uneven surface.

Historically, structures have been levelled by propping them up, for example by pushing wedges under their base or supports. However, this suffers from the problem  
20 that a wedge is often not available when required. Furthermore, it is a difficult matter to achieve a level platform using wedges because it is not simple to push a wedge

under the base or support of a structure to the required amount without extensive trial and error.

- To cope with this problem a known table, for example for garden use, has a levelling device comprising four lockable telescopic legs. Each leg has a foot and a sleeve wherein the foot is telescopic with the sleeve. Securing bolts are provided for locking the feet in place wherein each bolt is screwed radially through a sleeve and abuts a foot. However, it has been found that this known levelling device is difficult to adjust.
- 5 GB1432041 discloses a lifting cradle wherein each foot includes a hydraulic aligning jack, the jack of all lifting and positioning feet being connected to a common hydraulic apparatus through valves associated with each individual aligning jack. This arrangement suffers from the problem that it is not suitable for use with a structure such as a ladder in view of the fact that there is no configuration of jacks wherein
- 10 jacks within a group are in fluid communication with each other, but each group is isolated from each other.
- 15

EP0559474 discloses a desk having self-levelling height adjustment and an associated hydraulic circuit. Again, the arrangement disclosed is not suitable for a ladder in view of the fact that levelling of the desk can only be achieved by continuing to pump hydraulic fluid into a lower chamber of a master cylinder until the desk top is raised to the upper limit of its range. In this position pistons of the master and slave cylinders

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are raised to allow hydraulic fluid to flow through cylinder bypasses. However, there is no possibility of levelling the desk unless the desk top is raised. In addition, unless the desk top is raised, none of the slave cylinders are in fluid communication with each other. Thus, either all of the cylinders are in fluid communication in a first  
5 configuration or none of the cylinders are in fluid communication in a second configuration. This results in the problem that the feet of the desk are lifted from the ground if the desk is tilted in any direction while the levelling device is in the second configuration..

10 EP0186714 discloses a quick-levelling apparatus for levelling eg. a table. The apparatus comprises at least three bellows containing a pressure medium. Each medium is connected through a conduit to a central operating block which interconnects the conduits. Again, this arrangement is not suitable for levelling a structure such as a ladder in view of the fact that in one configuration all conduits are  
15 connected or in an alternative configuration no conduits are connected. There is no configuration wherein individual conduits within a group are in fluid communication with each other, but separate groups are isolated.

US5161625 discloses a pile driving apparatus which is supported on jacks. There is  
20 no suggestion that these jacks are hydraulically operated. In addition, there is no suggestion that the jacks are linked to each other by hydraulic means.

US4230304 discloses an arrangement for obtaining equal travel of hydraulic cylinders.

There is no suggestion of cylinders which remain in fluid communication having no valve between them.

- 5 US3768766 discloses a table levelling device. The device suffers from the same problems as the device of EP0186714.

In order to address the problems referred to above, a known ladder includes a levelling device having legs of adjustable length each of which comprise a bolt coaxial with the  
10 leg which can be screwed outwardly or inwardly into the base of the leg. However, this has been found to suffer from the problem that it is difficult to hold simultaneously the ladder securely and adjust the height of the legs.

Therefore, a need exists for a new device for levelling a structure such as a ladder  
15 which is safe and can be used easily and quickly by a single person.

The present invention addresses the problems set out above.

Remarkably, it has now been found that the present invention, when incorporated into  
20 the design and manufacture of a ladder ensures that the ladder has within its construction the ability to be levelled on site, without the use of any additional or extraneous items or articles.

Consequently, in a first aspect the present invention provides a hydraulic device for levelling a structure such as a ladder which comprises at least four pistons, four cylinders, a valve and tubing, wherein the tubing is between the valve and the cylinders, each piston fits inside a cylinder with a fluid seal; each piston is in fluid communication with the valve; the position of the piston with respect to the cylinder is capable of being adjusted by adjusting the amount of hydraulic fluid in the tubing between the piston and the valve; and the valve is positioned between groups of cylinders/pistons wherein each group is in fluid communication and linked by tubing with no valve.

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Advantageously, an embodiment of the invention can be incorporated into the design and manufacture of an item that may require a levelling device. In this regard, preferably an embodiment of the invention is produced integrally with a structure such as a ladder. Preferably the structure is a piece of furniture including a table or chair, or a tool including a ladder or work bench. Most preferably, the structure is a ladder. Alternatively, an embodiment of the invention can be produced separately and fixed to a structure, for example by bolting it to the structure. The invention provides the advantage that in an embodiment, a structure is capable of being levelled in two dimensions only.

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Preferably an embodiment of the invention comprises a valve which is a tap. This provides the advantage that the valve can be easily opened and closed manually when required.

- 5 Preferably an embodiment of the invention has a piston which forms at least part of the leg or foot of a structure. This provides the advantage that a platform of a structure comprising the platform can be levelled easily and quickly. This can be achieved by merely placing the structure where required; opening the valve to allow hydraulic fluid to flow past the valve; manually adjusting the position of the structure
- 10 to position the piston as required; and, when this is achieved, turning the valve to a closed position whereby hydraulic fluid is prevented from passing the valve.
- Subsequently, the structure can be moved to a new location, and it can be levelled again by repeating the above procedure.
- 15 Preferably, each group of cylinders/ pistons are in fluid communication with each other and the valve is capable of blocking this communication. This provides the advantage that when there is fluid communication between the groups of cylinders, one piston extends from its corresponding cylinder as the other pistons are retracted into their corresponding cylinders. When fluid communication is blocked by the valve each group
- 20 of pistons is isolated from each other and only pistons within a group are in fluid communication with respect to each other.

Preferably, each group of cylinders/pistons comprises a pair. Each pair forms at least part of a leg or foot of a structure such as a ladder. Preferably one cylinder/piston of each pair is located at a heel of the foot and a second cylinder/piston of each pair is located at the toe of the foot. This arrangement provides the advantage that a structure such as a ladder comprising a device of the invention can be easily and quickly levelled in the lateral plane of the ladder so that it is secure against lateral rotation about its contact with a floor surface. However, the ladder is free to rotate in a perpendicular plane about its contact with the floor surface. Advantageously, this allows the ladder to be levelled vertically with all its feet on the floor surface and then tilted against a structure while keeping all its feet securely on the ground.

Preferably an embodiment of the invention comprises a single valve which is capable of blocking fluid communication between at least two pairs of cylinders and pistons. Thus, the invention provides the advantage of interlinked hydraulic cylinders, controlled by a central valve system.

Preferably, an embodiment of a levelling device according to the present invention comprises any number of cylinders and pistons which are joined to the valve by tubing. This provides the advantage that the invention is versatile and can be used for levelling complex structures.

Preferably, an embodiment of a levelling device according to the present invention comprises electrically operated valve(s). Preferably each electrically operated valve is operated by a motor connected to a power source and a switching means. Preferably the switching means is an electrical switch. This provides the advantage that an embodiment  
5 of the levelling device can be operated easily without requiring manual force to operate the valve(s).

Preferably, an embodiment of a levelling device according to the present invention comprises an alarm means which indicates when a platform of a structure comprising the  
10 platform is not level or unsafe. Preferably the alarm means comprises a visual signal, for example a light, or audible signal, for example a bell, whistle or electronic sound. This provides the advantage that a platform can be levelled precisely.

Preferably an embodiment of a levelling device according to the invention comprises an  
15 alarm means which indicates when one or more of the valves are open. This provides the advantage of indicating when the platform is safe to use, such as would be the case for a ladder.

Preferably, an embodiment of a levelling device according to the present invention  
20 comprises components produced of metals or plastics. For example, preferably the tubing is produced of plastics. This provides the advantage that the device is light-weight.

Preferably, an embodiment of a levelling device according to the present invention comprises plugs positioned on the valve and/or the tubing wherein additional cylinders/pistons or additional groups of cylinders/pistons can be plugged into to the device via additional tubing. This provides the advantage of providing a versatile "plug and play" device.

Preferably, an embodiment of a levelling device according to the present invention comprises a lifting cylinder and piston for lifting a structure wherein the lifting cylinder and piston are in fluid communication with the piston/ cylinders of the device, but they do not form part of a leg or foot of a structure. This provides the advantage that the pistons of a levelling device according to the invention can be extended from their respective cylinders by forcing the lifting piston into its cylinder. When a structure comprising the device is lifted to a required height a valve blocking fluid communication with the lifting cylinder and piston can be closed.

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In a second aspect the invention provides a method for levelling a platform which comprises fixing an embodiment of a device according to a first aspect of the invention to a structure comprising the platform, opening a valve of the device, positioning the platform and closing the valve when the platform is positioned as required.

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Additional features and advantages of the present invention are described in, and will be apparent from, the description of the presently preferred embodiments which are set out below with reference to the drawings in which:

25 Figure 1 shows a hydraulic schematic of an embodiment of the invention:

Figure 2 shows an example of how an embodiment of the invention can be used.

For the purposes of clarity and a concise description features are described herein as part of the same or separate embodiments, however it will be appreciated that the scope of the invention may include embodiments having combinations of all or some of the features described.

As seen in Figures 1 and 2 a hydraulic levelling device (1) for levelling a ladder (wherein the bottom rung (6) is shown) comprises four metal pistons (2, 3, 4, 5), four metal cylinders (7, 8, 9, 10), a single valve that is a tap (11) and plastics tubing (12), wherein the tubing (12) joins two pairs of cylinders (7,8) and (9,10) and the tap (11) to each pair of cylinders (7, 8) and (9, 10).

The piston (2, 3, 4, 5) fits inside the cylinder (7, 8, 9, 10) with a fluid seal and is in fluid communication with the tap (11). The position of the piston (2, 3, 4, 5) with respect to the cylinder (7, 8, 9, 10) is capable of being adjusted by adjusting the amount of hydraulic fluid in the tubing (12) between the piston and the tap (11).

The device (1) is produced integrally with a ladder comprising a bottom rung (6). Each piston (2, 3, 4, 5) forms at least part of the leg or foot of the ladder.

The ladder (6) can be levelled easily and quickly. This can be achieved by merely placing the ladder where required; opening the tap (11) to allow hydraulic fluid to flow past the tap (11); manually adjusting the position of the ladder to position the piston (2, 3, 4, 5) as required; and, when this is achieved, turning the tap (11) to a closed position whereby  
5 hydraulic fluid is prevented from passing the tap (11). Subsequently, the ladder can be moved to a new location, and the platform (6) can be levelled again by repeating this procedure.

When the tap is open, all of the pistons are in fluid communication with each other. One  
10 piston (2) extends from its corresponding cylinder (7) as the other pistons (3, 4, 5) are retracted into their corresponding cylinders (8, 9, 10). When fluid communication is blocked by the tap (11) each pair of pistons (2, 3) and (4, 5) are isolated from each other, but the members of each pair remain in fluid communication with each other. Thus, when the tap is closed, if one piston (2) extends from its corresponding cylinder (7), its pair (3)  
15 is retracted into its corresponding cylinder (8), but this has no effect on the other pair of pistons (4, 5).

In a preferred embodiment, a levelling device (1) according to the invention comprises an electrically operated tap (11). Preferably the electrically operated tap (11) is operated  
20 by a motor connected to a power source and an electrical switch.

In a preferred embodiment, a levelling device (1) according to the invention comprises an alarm means comprising a light which indicates when a ladder (6) of a structure comprising the device (1) is level.

- 5 In a preferred embodiment, a levelling device (1) according to the invention comprises plugs positioned on the tap (11) and/or the tubing (12) wherein additional cylinders/pistons can be plugged into to the device (1) via additional tubing (12).

- In a preferred embodiment, a levelling device (1) according to the invention comprises  
10 a lifting cylinder and piston for lifting the ladder wherein the lifting cylinder and piston are in fluid communication with the pistons (2, 3, 4, 5)/ cylinders (7, 8, 9, 10) of the device (1), but they do not form part of a leg or foot of the table. Therefore pistons (2, 3, 4, 5) can be extended from their respective cylinders (7, 8, 9, 10) by forcing the lifting piston into its cylinder. When the table comprising the device (1) is lifted to a required  
15 height a tap blocking fluid communication with the lifting cylinder and piston can be closed.

- It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes  
20 and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications are covered by the appended claims.

## Claims

1. A hydraulic device for levelling a structure such as a ladder which comprises at least four pistons, four cylinders, a valve and tubing, wherein the tubing is between the valve and the cylinders, each piston fits inside a cylinder with a fluid seal, each piston is in fluid communication with the valve, the position of the piston with respect to the cylinder is capable of being adjusted by adjusting the amount of hydraulic fluid in the tubing between the piston and the valve; and the valve is positioned between groups of cylinders/pistons wherein each group is in fluid communication and linked by tubing with no valve.
2. A device according to claim 1 which is produced integrally with a structure such as a ladder.
3. A device according to claim 1 or 2 wherein the valve is a tap.
4. A device according to any preceding claim wherein the pistons form at least part of a leg or foot of the structure.
5. A device according to any preceding claim wherein each piston forms at least part of the leg or foot of a structure.



6. A device according to any preceding claim wherein the cylinders/ pistons are arranged in groups which remain in fluid communication with each other so that when there is fluid communication between the groups of cylinders, one piston extends from its corresponding cylinder as the other pistons are retracted into their  
5 corresponding cylinders, but when fluid communication is blocked by the valve each group of pistons is isolated from each other and only pistons within a group are in fluid communication with respect to each other.
7. A device according to claim 6 wherein each group of cylinders/pistons comprises  
10 a pair and one cylinder/piston of each pair is located at a heel of a foot of a structure and a second cylinder/piston of each pair is located at the toe of the foot.
8. A device according to any preceding claim which comprises a single valve which is capable of blocking fluid communication between at least two pairs of cylinders/  
15 pistons.
9. A device according to any preceding claim which comprises a plurality of cylinders and pistons in fluid communication via tubing and a valve.
- 20 10. A device according to any preceding claim wherein the valve is positioned between groups of cylinders/ pistons wherein each group is in fluid communication and linked by tubing with no valve.

11. A device according to any preceding claim wherein the valve(s) is electrically operated.
- 5 12. A device according to any preceding claim which comprises an alarm means that indicates when a structure comprising the device is level.
13. A device according to any preceding claim which comprises an alarm means that indicates when one or more valve(s) are open.
- 10 14. A device according to any preceding claim which comprises components produced of metals or plastics.
- 15 15. A device according to any preceding claim which comprises plugs positioned on the valve and/or the tubing wherein additional cylinders/ pistons can be plugged into to the device via additional tubing.
- 20 16. A device according to any preceding claim which comprises a lifting cylinder and piston for lifting a structure wherein the lifting cylinder and piston are in fluid communication with the piston/ cylinders of the device, but they do not form part of a leg or foot of a structure.

17. A device as shown or as described with reference to the accompanying drawings.
18. A method for levelling a structure such as a ladder which comprises operating a device according to any one of the preceding claims.



INVESTOR IN PEOPLE

Application No: GB 0206153.9  
 Claims searched: 1-18

Examiner: Dave McMunn  
 Date of search: 4 September 2002

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
 UK Cl (Ed.T): B8J. B8L (LFB). E1S (SP, SLW3). F1P (P9).  
 Int Cl (Ed.7): B66F 3/46, 7/20. E06C 7/44.  
 Other: ONLINE : WPI, EPODOC, JAPIO.

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	GB 2,340,529 A (WHITEHOUSE). See Figs	12
X	GB 2,241,936 A (CONGLETON). Note valve equivalent 50 in Fig 3	1,8-10, 14,18
X	GB 2,118,138 (POWER LIFTS). Note valve 24A or B & rams 20A or 20B in Fig 3	1,8-10, 14,18
X, Y	GB 1,452,249 (FRANCHIN). Note circuit shown in Fig 2 & integral leg construction shown in Fig 1	X:1,2,4,5, 8-10,14,18 Y:12
A	NL 1000235 C (BAIS & GUYT). See Figs	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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